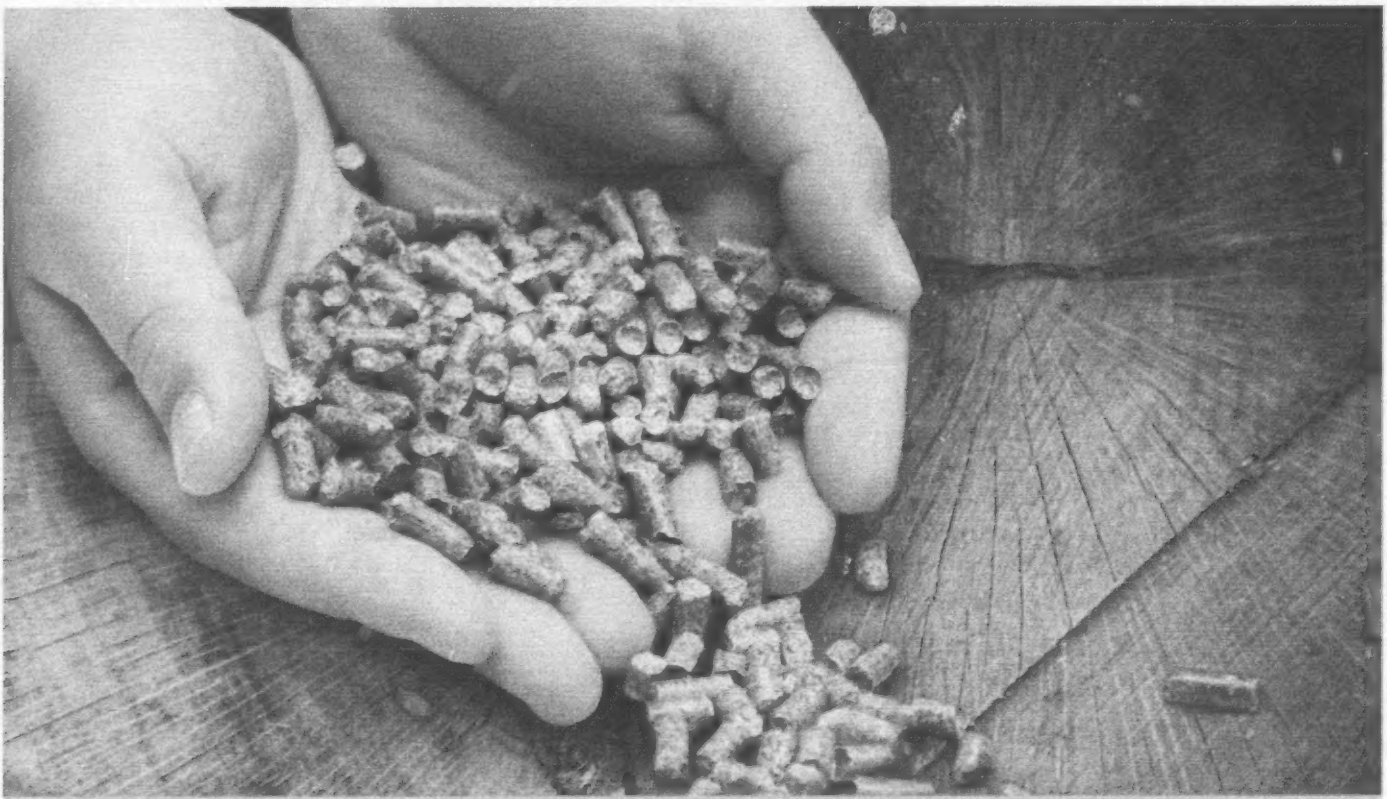
Save Energy and Save the Environment

PUBLIC WORKS AND SERVICES ENERGY CONSERVATION PROJECTS

Annual Report 2010



Prepared By

Design and Technical Services
Public Works and Services
Government of the Northwest Territories
April 2011

Northwest Territories

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Minister's Message

Guided by the framework established by the Government of the Northwest Territories (GNWT) 2008 Energy Priorities Investment Plan, the Department of Public Works and Services (PWS) refocused its operations in order to enhance implementation of energy conservation projects, programs and initiatives. Since that time, the successes achieved in both reducing the GNWT's fuel oil consumption, and reducing the amount of greenhouse gas emissions have been impressive.

This annual report outlines the Department's role in helping the GNWT achieve its energy priorities. It provides details on the progress of programs such as biomass heating systems, energy retrofit programs, and alternative energy. This report also outlines the GNWT's use of new energy efficient building techniques and guidelines which have made the Northwest Territories a leader in the field of energy efficiency in northern climates.

The accomplishments that are outlined in this report are an example of what can be achieved through innovation and dedication when cost savings and environmental sustainability are made a priority by Northerners.

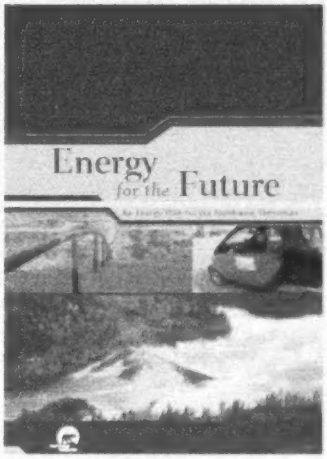
The Honourable

Michael McLeod

Minister of Public Works and Services

Overview

The Government of the Northwest Territories (GNWT) is working towards the goals established by the 2007 Energy Plan and Greenhouse Gas Strategy to "...reduce its own energy consumption". In October 2008, the Government of the Northwest Territories released the Energy Priorities Investment Plan (Framework). The Framework was built upon the 2007 Energy Plan and identified the energy priorities of the GNWT: displace the use of imported diesel fuel for energy generation; reduce greenhouse gas emissions; and reduce the cost of living in NWT communities. The Government's commitment and investment in energy management over the past five years has reduced its energy consumption and greenhouse gas emissions and achieved significant financial and operational savings.



The Department of Public Works and Services has continued to undertake numerous energy efficiency activities in planning, designing, building, maintaining and operating government-funded buildings and facilities in support of the Government of the Northwest Territories 2007 Energy Plan and Energy Priorities Investment Plan. Energy savings and greenhouse gas reduction activities include:

Reducing consumption of fossil fuels through the use of alternative sources of energy (biomass, hydroelectricity, solar and other) through:

- Installations of biomass boiler systems in individual buildings and in district heating systems to supplement oil fired boiler plants
- Use of electric boilers and other electrical equipment in Fort Smith when excess hydro power is available from the Taltson Hydro Dam
- Installation of solar photovoltaic panels
- Heat recovery projects

Reducing the consumption of fossil fuels and increasing building energy system efficiencies through the Capital Asset Retrofit Fund (CARF) by:

- Benchmarking energy intensities of various types of buildings such as schools, healthcare facilities or commercial buildings across the NWT
- Thermal analysis of GNWT and municipal buildings in various communities across the NWT
- Conducting preliminary inspection of mechanical and electrical building systems to identify energy conservation opportunities in various NWT communities
- Completion of detailed energy audits on buildings with large energy savings potential
- Selection from detailed energy audits of optimum buildings for an energy retrofit
- Upgrading HVAC equipment, building envelope, lighting systems and controls with a focus on energy efficiency
- Development of a plan to track actual energy savings and reinvest into the Capital Asset Retrofit Fund to make the program self-perpetuating

In addition, PWS helps to reduce energy usage and increase energy efficiency by:

- Developing, updating, and using "***Good Building Practice for Northern Facilities***" guidebook for the design and construction of buildings to reduce energy consumption and ensure quality control
- Conducting design reviews and energy modelling workshops to ensure new GNWT assets have 25% or better energy performance than a base building adhering to the Model National Energy Code for Buildings (MNECB)
- Commissioning construction projects with a focus to optimize building energy consumption, operation and user satisfaction
- Promoting public awareness of energy use and conservation, community energy planning, participation in energy fairs, and sharing information and expertise with other groups and Territories

This report provides an update of PWS managed projects and energy conservation initiatives up to December 31, 2010. Energy conservation projects reported are biomass boiler heating systems in various communities such as Yellowknife, Hay River, Fort Smith, Behchoko and N'Dilo, electric heat conversions in Fort Smith which utilize sustainable hydroelectricity, solar PV and waste heat recovery projects as well as energy efficiency benchmarking of almost 100 of the GNWT's assets which has led to the completion of detailed energy audits of over 35 buildings in approximately 20 communities.

Energy Conservation initiatives such as the PWS Capital Asset Retrofit Plan has funded energy retrofits in approximately 16 buildings, in various communities such as Aklavik, Deline, Fort Good Hope, Inuvik, Tsiigehtchic, Norman Wells, Yellowknife and Behchoko. An initiative was taken to effectively track utilities consumption and expenditures through the consolidation of GNWT utility payments to the PWS department. As well as initiatives involving the usage of the EcoEnergy Validation Protocol, "***Good Building Practice For Northern Facilities***" and commissioning of new facilities which have helped to reduce overall lifecycle costs for new and renovated GNWT facilities. PWS had tremendous success in planning, designing and installing biomass heating systems. The NWT leads the country in the installation of wood pellet (Biomass) boilers.

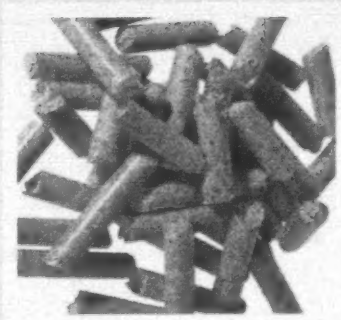
Energy Savings Projects

The Northwest Territories is highly dependent on fossil fuels as a primary source of heating and electricity. Each year the Northwest Territories consumes the equivalent of approximately 174,000,000 litres of fuel oil for space heating and electricity generation (Northwest Territories Energy Report, ITI, May 2011). This releases approximately 475,000 tonnes of greenhouse gas (GHG) emissions. The desire to reduce GHG production from fossil fuels, along with the volatility in fuel prices and the potential for rising fuel costs, makes present energy saving initiatives a sound investment for the future.

PWS undertook several energy conservation projects over the past four years. Below is an overview of specific PWS projects completed through the Energy Plan and the Energy Priorities Framework to reduce GNWT energy use and greenhouse gas emissions.

Biomass

Biomass comes in many forms of organic matter but the most common form used for heat generation is wood, in the form of logs, chips and more recently, pellets.



Why is There a Demand to Use Biomass?

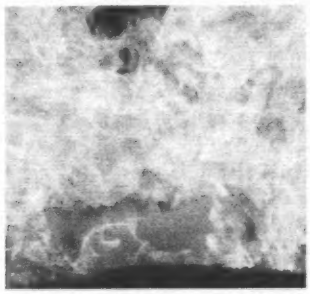
- Reduction in Carbon Dioxide (GHG)
- Reduction in Global Warming
- Reduction in Cost of Living

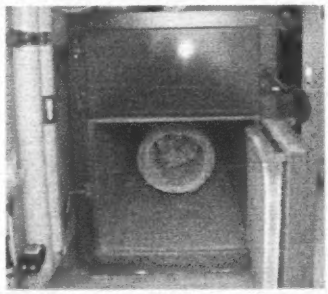
Wood pellets are generally produced as by-products of forestry mills. Wood shavings and sawdust are compressed under high heat and pressure to form uniformly sized pellets. Lignin, which forms naturally in wood, holds the shape of a pellet together, eliminating the need for any additives and, therefore, contaminants. Transport and storage equipment for wood pellets is similar to what would typically be used for grain. Silos, tankers, augers and blowers can all be used to transport and store wood pellets.

The burning of wood pellets is considered "Carbon Neutral". The use of wood pellets helps to alleviate the production of harmful greenhouse gases. Although pellets need to travel a fair distance from northern Alberta, the high energy content and ease of transport make wood pellets less expensive than heating fuel oil per equivalent energy content. Wood pellet prices are much more stable when compared to the volatility of the market for fossil fuels such as heating oil, diesel and gas. One of the key initiatives included in the 'GNWT Energy Priorities Investment Plan' is to expand the use of biomass as a heating fuel source to reduce the consumption of fossil fuels and the production of greenhouse gas emissions in GNWT buildings.

A feasibility study is conducted prior to the design of a biomass project. The information collected from these studies allows PWS to initially determine if a biomass project would make economic sense. This feasibility study gives designing engineers a rough idea of how to properly size the wood pellet boiler. Boiler sizing is a critical step in optimizing the efficiency of a wood pellet system. Wood pellet boilers are typically sized for 50% of the peak winter heating demand. This allows a wood pellet boiler to provide adequate heat for a building 90% of the year and optimizes the efficiency of the plant by minimizing wasteful cycling of the boilers (which would occur if the boilers were oversized). Limiting the size of a wood pellet boiler also minimizes the capital costs for construction and improves the project payback period. Existing oil or gas-fired systems remain in operation to meet peak demands and act as back-up heat systems.

The economic payback on biomass projects varies with the market price of heating fuel. Prior to the summer of 2008, oil prices were above $1.20 per litre, resulting in payback periods as low as three to five years. With the recent recession and decline in heating fuel prices, the payback for these projects is typically in the five to ten year range. Wood pellet boilers increase the life of the existing heating plant in any building since the installation limits the usage of the existing boilers, which means that capital upgrade costs can be deferred for many years, as hours of use on existing equipment are drastically reduced.





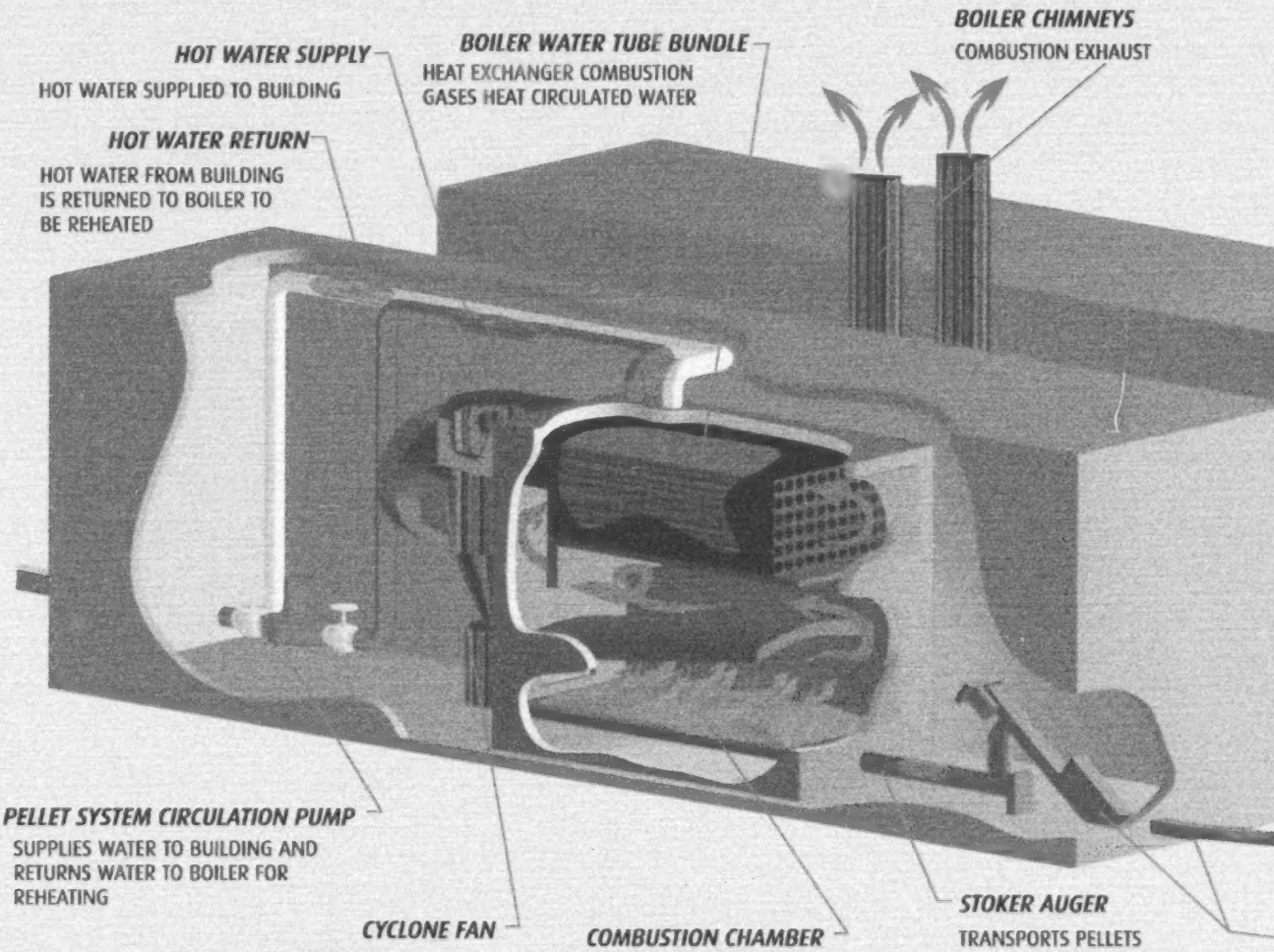
Biomass Heat – Renewable Energy

The U.S. Environmental Protection Agency (EPA) has endorsed wood pellet heat as one of the cleanest burning, most renewable energy sources on Earth.

Wood Pellet (Biomass Heating) Technology is becoming well established in the Northwest Territories.

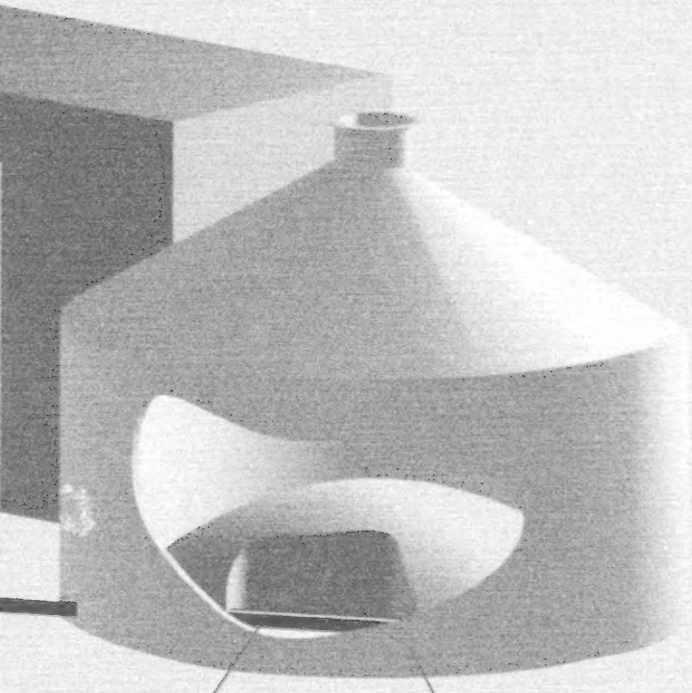
A typical system includes a wood pellet (fuel) storage silo. The wood pellets are fed into to the combustion chamber from the silo by an automatic auger feed system at a rate determined by the control settings. The system is automatic, controlled by a digital electronic control system equipped with alarms and trending logs that are fed via internet to the operator's computer work station. The system is also equipped with an automatic system that removes ash, the volume of which is approximately 1% of the pellets burned.

Conceptual Layout of a Typical Biomass Heating System


HOT WATER SUPPLY
HOT WATER SUPPLIED TO BUILDING
HOT WATER RETURN
HOT WATER FROM BUILDING IS RETURNED TO BOILER TO BE REHEATED
BOILER WATER TUBE BUNDLE
HEAT EXCHANGER COMBUSTION GASES HEAT CIRCULATED WATER
BOILER CHIMNEYS
COMBUSTION EXHAUST
PELLET SYSTEM CIRCULATION PUMP
SUPPLIES WATER TO BUILDING AND RETURNS WATER TO BOILER FOR REHEATING
CYCLONE FAN
CYCLONIC ACTION STRIPS DUST AND MATTER FROM FLUE GASES AND DEPOSITS WASTE IN COLLECTION BIN
COMBUSTION CHAMBER
PELLETS ARE BURNED PRODUCING HEAT EXCEEDING 1000°C
STOKER AUGER
TRANSPORTS PELLETS INTO THE COMBUSTION CHAMBER TO BE BURNED

What You should Consider When Selecting a Biomass Heating System
Project Justification

- Review the cost-effectiveness to get a preliminary sense of whether wood pellet heating will make financial sense.
- Undertake a preliminary feasibility study to determine whether the wood pellet heating will be cost effective. This study will include the preliminary analysis of specific data such as building heating load, building size and location, cost of wood pellets, cost and availability of back-up heating fuel and electricity, initial investment required, return on investment, rate of cost escalation for wood pellets, back-up fuel and electricity, amount of heating fuel displaced, reduction in greenhouse gas emissions, project delivery options (buy biomass heating system or buy heat), etc
- Ensure the size of the boiler system will suit your requirements. Recommend sizing wood pellet boiler to meet 50% of peak load. This will meet building heating requirements for approximately 90% of the year. Oversized or undersized boilers are less efficient and have a shorter lifespan.
- Since the materials in the hot sections of the boiler are exposed to severe stress, check the quality and temperature limits of the refractory lining, the wall thickness, and serviceability of parts.
- Boilers must be approved by the Canadian Standard Association (CSA) and must meet the GNWT regulatory requirements.
- Learn about the air quality permitting requirements in the area and work with air quality regulators (i.e., ENR) to determine whether any special design features would be required, i.e., Cyclone System.



TRANSPORT AUGER
EXTRACTS PELLETS FROM STORAGE SILO TO STOKER AUGER

PELLET SILO
STORAGE FOR PELLETS KEEPING THEM OUT OF THE ELEMENTS

For more information contact:
Design and Technical Services
Public Works and Services
Government of the Northwest Territories
Telephone (867) 920-6461

Biomass Projects Completed

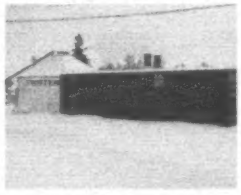
Several major GNWT facilities have already been retrofitted with biomass heating systems burning wood pellets to reduce the fossil fuel consumption and greenhouse gas emissions.

The major assets retrofitted to date with biomass heating include:

- North Slave Correctional Facility – Yellowknife
- Sir John Franklin High School – Yellowknife
- K'alemi Dene School – N'Dilo
- Chief Jimmy Bruneau School – Behchoko
- École St. Joseph School – Yellowknife
- Legislative Assembly Building – Yellowknife
- Highways Maintenance Garage – Hay River
- PWK School and Recreation Centre – Fort Smith
- Thebacha College – Fort Smith
- Harry Camsell School – Hay River
- Princess Alexandra School – Hay River
- École Boréale – Hay River
- Diamond Jenness Secondary School – Hay River
- Diamond Jenness Trades Shop – Hay River

North Slave Correctional Facility – Yellowknife

The biomass boiler installation at the North Slave Correctional Facility in Yellowknife consists of two 750 kW wood pellet boilers. It was commissioned in November of 2006. An energy service provider bills the GNWT for heat supplied to the facility at a rate guaranteed to be 10 cents below the calculated cost of the equivalent heat extracted from one litre of fuel oil, (for oil at a cost between $0.68 and $0.78 per litre), with savings increasing proportionally as oil price escalates over $0.78 per litre.



North Slave Correctional Facility

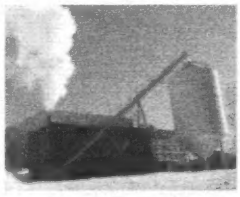
Boiler Type: .....Binder
Size: .....2 x 750 kW
Silo Capacity: .....80 Tonnes

Annual anticipated savings of 587,000 litres of oil and a total greenhouse gas reduction of 1,560 tonnes were projected. Since the commissioning in 2006 to December 31, 2010, the wood pellet boilers have displaced approximately 2,288,197 litres of fuel oil, resulting in a greenhouse reduction of 6,247 tonnes, equivalent to taking 1,250 vehicles off the road. On average, this installation achieves savings of 580,017 litres of oil and 1,585 tonnes of greenhouse gas emissions annually.

The wood pellet boiler installation at the North Slave Correctional Facility was the first of its kind in the Northwest Territories, and one of the first such installations in Canada. The success of this installation has proven that biomass technology is economically and technologically viable in the North, paving the way for future installations of wood pellet boilers.

Sir John Franklin High School – Yellowknife

Through a contract between the Yellowknife (YK) Education District #1 and an energy service provider, a 750 kW wood pellet boiler was brought into operation in February of 2008 at the Sir John Franklin High School in Yellowknife. Similar to the contract at NSCF, an energy service provider bills YK Education District #1 for heat supplied to the facility by the wood pellet boiler at a rate guaranteed to be 10 cents below the calculated cost of the equivalent heat extracted from one litre of fuel oil for oil costs between $0.68 and $0.78 per litre, with savings increasing proportionally as fuel price escalates.



Sir John Franklin High School

Boiler Type: .....Binder
Size: .....750 kW
Silo Capacity: .....40 Tonnes

Anticipated annual savings for this installation were approximately 212,454 litres of oil, resulting in a reduction of 580 tonnes of greenhouse gas emissions. In the first full year of follow up in 2009, this wood pellet boiler displaced 273,196 litres of fuel oil, resulting in a greenhouse gas reduction of 746 tonnes.

K'alemi Dene School – N'Dilo

The new K'alemi Dene School in N'Dilo was designed with three small 23 kW residential wood pellet boilers to serve the heating needs of the school. One of these boilers is capable of offsetting 10,000 litres of fuel oil annually. The three boilers were installed inside a sea container adjacent to the building. Two 142 kW oil-fired boilers have also been installed to meet peak demands, and provide backup to the wood pellet boilers.

The school was commissioned in September of 2009 and has since been operating with the wood pellet boilers. It was estimated that the wood pellet boiler would offset fuel oil usage by approximately 30,000 litres and reduces greenhouse gas emissions by 80 tonnes annually.

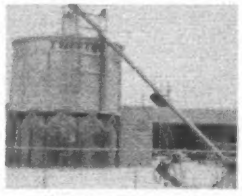
K'alemi Dene School

Boiler Type: .....Bosch
Size: .....3 x 23 kW
Silo Capacity: .....15 Tonnes

In the first year of follow-up, this biomass boiler installation displaced 28,481 litres of fuel oil, representing a greenhouse gas reduction of 76 tonnes. This biomass installation is achieving 95% of its anticipated savings.

Chief Jimmy Bruneau Regional High School – Behchoko

The Chief Jimmy Bruneau Regional High School in Behchoko currently consumes approximately 174,000 litres of oil per year for heating purposes. A 750 kW boiler was installed at a cost of approximately $450,000 to offset the usage of oil for heating. Fuel savings are an estimated 155,000 litres per year. Greenhouse gas emissions would be reduced by 420 tonnes per year. The boiler became operational in October 2009.



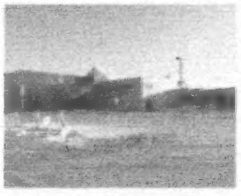
In the first year of follow-up, this biomass boiler installation has displaced 173,914 litres of fuel oil, representing a reduction in greenhouse gas emissions by 462 tonnes, equivalent to removing 92 vehicles from the road.

Chief Jimmy Bruneau Regional High School

Boiler Type: .....Binder
Size: .....750 kW
Silo Capacity: .....100 Tonnes

École St. Joseph School – Yellowknife

The 540 kW wood pellet boiler installation was provided as part of a renovation project in the École St. Joseph School in Yellowknife. The wood pellet boiler was commissioned in October 2009. Annual fuel oil savings were estimated at 102,770 litres, with a greenhouse gas reduction of 273 tonnes a year.



In the first year of follow up (November 2009 to November 2010) the biomass boiler was able to displace 72,715 litres of heating oil. This represents a greenhouse gas reduction of approximately 193 tonnes. The boiler was only in service for part of 2010, PWS expects the follow up year of 2011 to produce savings on target with the original estimates.

École St. Joseph

Boiler Type: .....KOB
Size: .....540 kW
Silo Capacity: .....50 Tonnes

Legislative Assembly Building – Yellowknife

The Legislative Assembly Building had a 300 kW wood pellet boiler installed and commissioned in October 2010. This wood pellet boiler will displace approximately 82,800 litres of fuel oil a year. Greenhouse gas production will be reduced by 232 tonnes annually.

The system was commissioned on October 31, 2010. From October 31 to December 31, 2010, the biomass boiler displaced 34,500 litres of heating oil. This represents a reduction in greenhouse gas emissions by 95 tonnes, equivalent to taking 19 vehicles off the road.

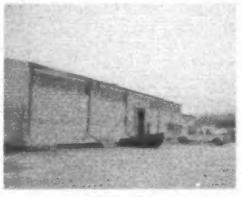
Legislative Assembly Building

Boiler Type: .....Binder
Size: .....300 kW
Silo Capacity: .....40 Tonnes

Highways Maintenance Garage – Hay River

A 300 kW wood pellet boiler was installed in the 4-Bay Highways Maintenance Garage. The boiler was commissioned in October 2010. This boiler installation will offset fuel oil consumption by approximately 100,000 litres per year. Greenhouse gases will be reduced by 270 tonnes annually.

The system was commissioned on October 30, 2010. From October 30 to December 31, 2010, the biomass boiler displaced 39,945 litres of heating oil. Greenhouse gas emissions were reduced by 109 tonnes, equivalent to taking 22 vehicles off the road.



Highways Maintenance Garage

Boiler Type: .....KOB
Size: .....300 kW
Silo Capacity: .....50 Tonnes

P.W. Kaeser High School and Recreation Centre – Fort Smith

A 750 kW wood pellet boiler was installed to provide heating for the PWK School and Recreation Centre in Fort Smith. The installation was commissioned in October 2010. Fuel oil will be displaced by approximately 200,000 litres per year. Greenhouse gas emissions will be offset by 533 tonnes per year.

The system was commissioned on October 30, 2010. From October 30 to December 31, 2010, the biomass boiler displaced 84,295 litres of heating oil. Greenhouse gas emissions were reduced by 230 tonnes, equivalent to taking 46 vehicles off the road.

PWK High School

Boiler Type: .....KOB
Size: .....750 kW
Silo Capacity: .....50 Tonnes

Thebacha College – Fort Smith

A 750 kW wood pellet boiler was installed in the Thebacha College in Fort Smith. This installation was commissioned in the fall of 2010. Estimated fuel oil savings total 200,000 litres. Annual greenhouse gas emissions will be reduced by approximately 533 tonnes.

The system was commissioned on October 31, 2010. From October 31 to December 31, 2010, the biomass boiler displaced 79,980 litres of heating oil. Greenhouse gas emissions were reduced by 219 tonnes, equivalent to taking 44 vehicles off the road.

Thebacha College
Boiler Type: .....KOB
Size: .....750 kW
Silo Capacity: .....50 Tonnes

Central Heating Plant – Hay River (A Mini-District Heating System)

A 1 MW wood pellet boiler was installed in a central heating plant in Hay River. The heating plant serves Harry Camsell School, Princess Alexandra School, École Boréale, Diamond Jenness Secondary School and Trades Shop. This boiler installation was commissioned in November 2010. Estimated displaced fuel oil totals 318,340 litres annually. Greenhouse gas emissions will be reduced by 846 tonnes annually.

The system was commissioned on November 12, 2010. From November 12 to December 31, 2010, the biomass boiler displaced 78,900 litres of heating oil. Greenhouse gas emissions were reduced by 216 tonnes, equivalent to taking 43 vehicles off the road.

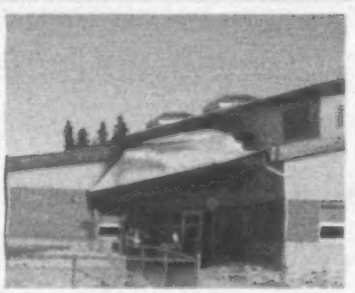
Central Heating Plant
Boiler Type: .....KOB
Size: .....1 MW
Silo Capacity: .....50 Tonnes

Harry Camsell School

Princess Alexandra School

DJSS Trades Shop

Diamond Jenness Secondary School



École Boréale School

Current Biomass Projects

Health Centre – Fort Smith

A 750 kW wood pellet boiler was installed in the Fort Smith Health Centre during the fiscal year of 2010-2011. The installation is to be commissioned in 2011. Estimated fuel oil savings will total 200,000 litres. Annual greenhouse gas emissions will be reduced by approximately 533 tonnes.

The shipping container holding the boiler for the Fort Smith Health Centre has been placed in its final location, with connection to the existing Health Centre heating system to be made in the spring of 2011 as part of the ongoing Health Centre renovation project.

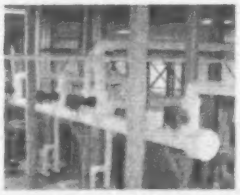
Health Centre

Boiler Type: .....KOB
Size: .....750 kW
Silo Capacity: .....50 Tonnes

Central Heating Plant – Fort Simpson

The Central Low Pressure Steam Heating Plant serving Thomas Simpson School, Bompass Elementary School and the Community Recreation Complex recently had its oil boilers replaced with new more efficient and more appropriately-sized oil boilers. The replacement was completed in October 2009. This retrofit has estimated operational savings of $130,000 and will reduce GHG production by 355 tonnes per year.

PWS has proposed a biomass system that would include a wood pellet boiler in the central heating plant complete with 30 days worth of pellet storage. It is estimated that displaced fuel oil would be 356,000 litres per year. Greenhouse gas emissions would be reduced by 947 tonnes, equivalent to removing 195 vehicles from the road. Such a system could also be expanded to service the heating needs of future GNWT buildings.



Central Heating Plant

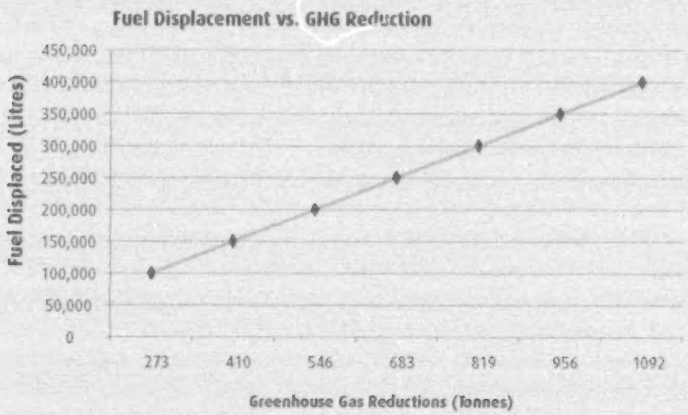
Boiler Type: .....TBD
Size: .....800 kW
Silo Capacity: .....110 Tonnes

The use of a wood pellet boiler for steam production in Fort Simpson will be the first of its kind in the Northwest Territories. Estimated operational savings under this scenario would be $178,000 per year, giving a simple payback of 6.7 years. These estimates are based on a cost for wood pellets equivalent to $0.50 per litre for heating fuel, and a fuel oil cost of $1.00 per litre. This project will be completed in 2011-2012.

Future Biomass Projects

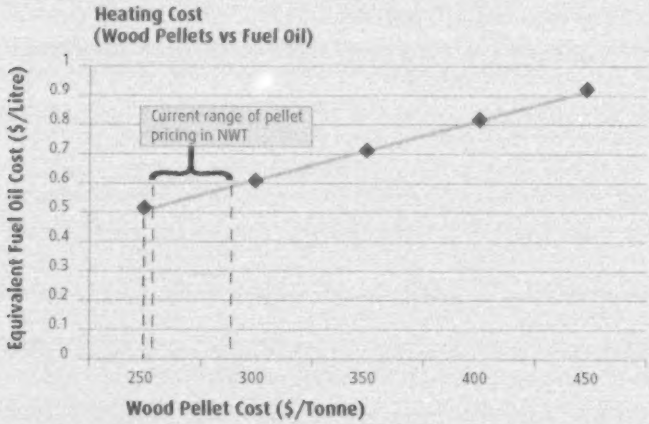
The world is slowly but surely recovering from the recession of the past two years. As economies recover, the demands for energy will likely rise. To prepare for potential rising energy costs PWS is analyzing the feasibility of using wood pellets boilers to heat even more buildings in the North.

Examples of other major buildings under consideration include: the Airport Terminal Building (Yellowknife), Stanton Territorial Hospital (Yellowknife), GNWT Office Building (Yellowknife), Territorial Women's Correctional Centre and River Ridge Young Offenders Facility (Fort Smith), Elizabeth MacKenzie School (Behchoko), Long Term Care Facility (Behchoko), Health Centre (Fort Simpson), GNWT Office Building (Fort Simpson), DOT Combined Service Building (Yellowknife), Long Term Care and Regional Health Centre (Norman Wells), Health Centre (Hay River), Air Terminal Building and Combined Service Building (Norman Wells), St. Patrick's and Weledeh Schools (Yellowknife) and the Mackenzie Mountain School (Norman Wells).



Fuel oil is the major contributor of Greenhouse gas emissions in the NWT. Typically one litre of fuel will release 2.73 Kg of CO_2 when burned.

Price of Wood Pellets ($/T)	50	100	150	200	250	300	350	400	450
Heating Cost Equiv. Oil ($/L)	.102	.204	.305	.407	.509	.611	.712	.814	.916



At current rates, the usage of wood pellets for space heating can reduce a buildings annual heating costs by over 45%. Low costs and relatively stable pricing make wood pellet heating very attractive in the North.

Heating Cost (Wood Pellets vs Heating Oil)
Price of Wood Pellets ($/Tonne) and Equivalent Heating Oil cost ($/Litre)

Summary – Biomass Projects

In the calendar year of 2010, biomass heating systems typical of the one displayed in Figure 1, displaced approximately 1.374 million litres of heating fuel oil. This is an equivalent greenhouse gas reduction of 3,736 tonnes. The displaced fuel oil and greenhouse gas reductions for projects commissioned in the fall of 2010 were included. With a full year in operation of all the biomass projects commissioned to date, PWS expects fuel oil savings to exceed 2 million litres and greenhouse gas emissions reduction to reach 5,934 tonnes. Actual yearly savings to date, as well as projected displacement of heating oil and reduction in greenhouse gas emissions for 2011, resulting from biomass heating systems, are represented in Charts 1 and 2 respectively. At this current rate of annual fuel oil and greenhouse gas reduction, approximately 55 million litres of fuel oil and 150,000 tonnes of greenhouse gas emissions will be reduced over the next 25 years.

Chart 1: Heating Oil Displaced (December 31, 2010)

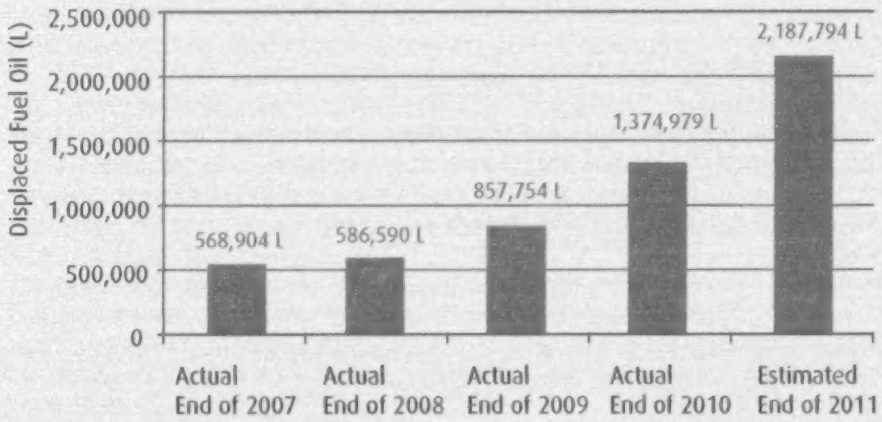
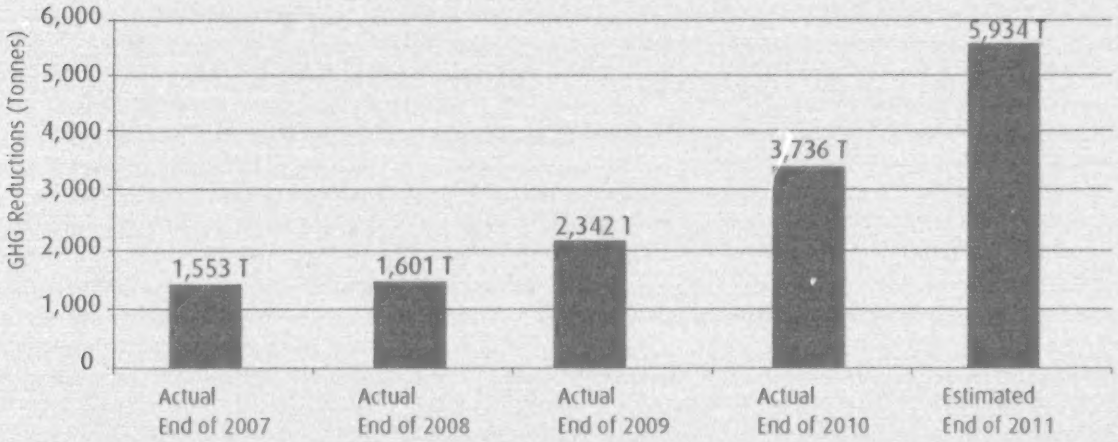


Chart 2: Reduction in Greenhouse Gas Emissions (December 31, 2010)



Electric Heat Conversions – Hydro

In 2001, PWS assessed the feasibility of using surplus hydroelectric power from the Taltson Hydro facility in the South Slave Region to heat GNWT buildings in Fort Smith. The Taltson facility has hydroelectric generating potential of 18 MW, of which approximately 8 MW is surplus. This surplus provided an opportunity to utilize electricity, on an interruptible basis, to heat public buildings.

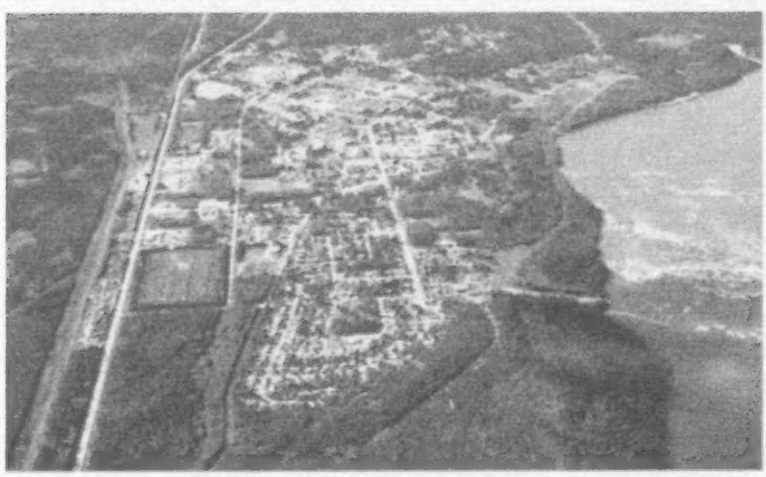
Taltson Hydro Dam

Interruptible power means that if another customer were to emerge in the South Slave region (interest has been expressed by resource development companies such as Avalon and Tamerlane), the power may no longer be available. This is why electricity for heating purposes was limited to public buildings. To be competitive with heating oil, electricity would need to be priced in the range of 8 cents per kilowatt hour, far below community electricity rates. Further, in order to ensure the public investment was recovered, electricity was priced at below 1 cent per kilowatt hour – another reason why this power is interruptible and limited to public buildings.

Electric Heat – Fort Smith

Twenty-seven buildings were studied and three scenarios were considered for the installation of interruptible power: conversion of 3 buildings, 17 buildings, or all 27 GNWT buildings in Fort Smith. Option one, which included the installation of electric heat in the PWS Records Storage Building, Breynat Hall and JBT Elementary School, was originally selected as it was deemed the most cost-effective option. These buildings were chosen because they did not require large infrastructure upgrades to the NTPC grid to incorporate the proposed retrofits. This kept the capital costs of the project lower and created a more attractive payback period.

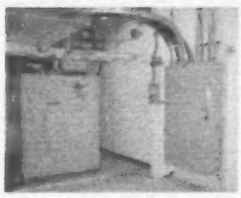
On January 26, 2007, the project was approved to connect three buildings to interruptible power (PWS Records Storage Building, Breynat Hall, and JBT Elementary School). For conversion of PWS Records Storage Warehouse, the scope of work was changed to install a "cold weather air-to-air heat pump" to provide heating in lieu of electric heat. An additional facility, the DOT Parking/Maintenance Garage, was included in the electric heat project.



Municipality of Fort Smith, Northwest Territories

J.B. Tyrell Elementary School – Fort Smith

The schools heating needs were served by two 831 kW Weil McLain oil-fired hot water boilers. The boilers provide heat to the perimeter radiation as well as the air handling units. Domestic hot water is provided by a heat exchanger served by the heating water system, as well as an electric heater installed as a backup.



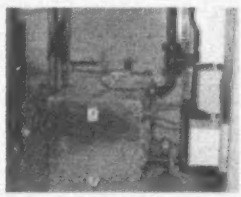
J.B. Tyrell Elementary
Boiler Type: .....Acme
Size: .....810 kW

Average annual oil consumption for the building was 166,208 litres. The peak heating load for the building was calculated to be 775 kW. Based on this information, a separate 1000A, 600V, 3-phase service was installed in the existing boiler room to connect one 810 kW electric hot water boiler. Controls were provided to operate the heating system with the electric boiler to provide the base heating load. The existing oil-fired boilers remained in service as backup.

Conversion of the JBT School was completed in November 2008 and the electric boilers were commissioned at that time. Expected savings were 129,000 litres of fuel oil and 369 tonnes of GHG emissions per year. Actual savings from November 2008 to October 2010 were 215,204 litres of heating oil; equivalent to a reduction of approximately 588 tonnes of greenhouse gas emissions, or removing 118 vehicles off the road.

Breynat Hall – Fort Smith

Two 880 kW oil-fired Weil McLain steam boilers originally serviced the heating needs of Breynat Hall. The steam boilers originally fed process steam for the kitchen and laundry facilities and provided heating to a hydronic network via steam to hot water heat exchangers. The kitchen and laundry facilities were discontinued, making steam no longer necessary. The existing boilers, along with all the steam ancillaries, were removed from the building. One new Acme Slim Model WGH-HP-720 electric hot water boiler, rated at 720 kW net I.B.R. output along with a new Weil McLain Model 1188 oil-fired hydronic boiler as backup, were installed for the heating system.



Breynat Hall
Boiler Type: .....Acme
Size: .....720 kW

The Breynat Hall conversion was completed in November 2008. Expected savings were 132,000 litres of fuel oil and 378 tonnes of GHG emissions per year. The actual savings from November 2008 to October 2010 were 169,460 litres of heating oil. This is equivalent to a reduction in greenhouse gas emissions by 463 tonnes or removing 93 vehicles from the road.

Highways Maintenance Garage – Fort Smith

Two oil-fired Weil McLain Model WGO-6 boilers, with a total rated net I.B.R. output capacity of 128 kW originally provided the heating needs of this 4-Bay maintenance garage. These boilers fed into a direct return pumped water/glycol heating supply system, providing heating to hydronic loops throughout the building.

Highways Maintenance Garage
Boiler Type:..... Acme
Size:.....83 kW

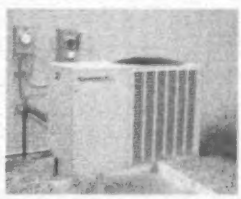
One new Acme Slim Model WGH-SL-150-83 electric hydronic boiler, rated at 83 kW net I.B.R. output, was installed to service the base load heating needs of this building. Controls were provided to operate the heating system with the electric boiler for the base load heating needs. The existing oil-fired boilers remain in service as backup.

The new electric boiler was installed and commissioned in the winter of 2009–2010. Oil use and GHG emission reductions were estimated at 20,000 litres and 52 tonnes per year respectively. For the period of April 2009 to March 2010 actual reductions were 14,506 litres of fuel oil and 38 tonnes of greenhouse gas emissions.

Savings for the Fort Smith electric heat conversion projects in the calendar year of 2010 totalled approximately 216,837 litres of displaced fuel oil. Greenhouse gas emissions were offset by approximately 592 tonnes. In addition to the direct energy and greenhouse gas emission reductions from the hydroelectricity, operational savings should also be considered, since the addition of the electrical equipment reduces the run time on the existing oil boilers, increasing the useful life of each buildings boiler plant.

PWS Records Storage Warehouse (Air to Air Heat Pump) – Fort Smith

Heating for the warehouse was provided by two oil-fired furnaces, rated at 55.6 kW output each. The furnaces were in good condition and PWS anticipated they would provide reliable service for the foreseeable future.



PWS Records Storage Warehouse
Unit: ..... Hallowell

Annual consumption of fuel oil was 23,403 litres. From this data, actual peak heating load by the ASHRAE winter design method was estimated at 109 kW.

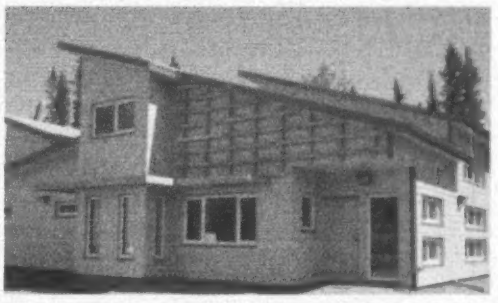
Two Hallowell air-to-air heat pumps were installed as a pilot project to establish the viability for the use of cold weather heat pumps in our northern environment. With a low electrical rate, a heat pump was very appealing, since the coefficient of performance on this type of heat pump is as high as 2.6. This means that for every unit of electrical energy you put into the system to operate the heat pump, you get 2.6 units of heat energy out. A heat pump makes it possible to transfer heat energy from outside (even at low outdoor temperatures) to use as heat for makeup air in the furnaces.

As this is a pilot project for air source heat pumps in northern climates, there were a number of setbacks with the operation of this system. Ice build up and snow drifting on the outdoor exchangers has proved to be an obstacle to the use of these units in a cold northern environment. Remedies such as adding snow fence around the outdoor units and upgrading the controls to optimize the heat pump operation have been implemented. Hallowell is supporting PWS on this pilot project for northern climate heat pump technology. PWS will continue to evaluate and refine this technology before moving forward with similar applications.

Solar

60th Parallel Visitor Center

Because of its remote location, the 60th Parallel Visitor Center relies on a diesel generator to provide the electrical needs of the building during the summer months of operation.



A retrofit of the building included the replacement of an electric oven, domestic water heater and clothes dryer to propane-fuelled units. The domestic hot water system was converted to an "on demand" system. A lighting conversion from old incandescent light bulbs to higher efficiency CFL's was also included. The reduction of the electrical demand in the building made it practical and economically feasible to install a 2.2 kW photovoltaic system, coupled with a 17 kWh battery bank. Reduced electrical demand in the building allows the solar PV's and battery bank to provide a majority of the power for the building. A new generator was selected and installed to provide power for the new demands of the building. A smaller generator avoids losses in efficiency from an oversized generator running at low idle to meet small demands.

Anticipated savings for this installation are approximately $6,000 a year. Greenhouse gas production should be reduced by approximately 5 tonnes a year.

Heat Recovery Projects

Data Centre – Yellowknife

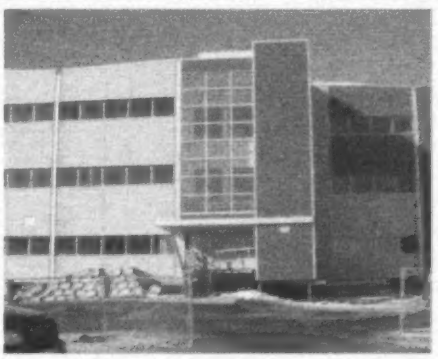
The new GNWT Data Centre in Yellowknife was commissioned in January 2011 and is currently being heated by the oil fired hot water boilers located in the adjacent GNWT Warehouse via underground heating mains. Two heat pumps have been installed in the mechanical room of the Data Centre to utilize the waste heat generated from the servers and ancillary computer equipment. This waste heat will initially be used to heat the Data Centre's space heating needs. Build out plans in the future will see the installation of more computer equipment in the server space.

Ultimately, the amount of recoverable waste heat will be such that not only will the total heat load of the Data Centre be provided for, but there will be excess heat that will be provided back to the Central Warehouse by reversing the flow in the underground mains connections. This will significantly reduce the fuel consumption and greenhouse gas emissions at the GNWT's Central Warehouse.

Initial annual fuel savings for the Data Centre are estimated at 19,207 litres of oil. After the five year build out plan, additional annual savings of 15,938 litres of fuel oil are estimated from reducing the consumption within the GNWT Warehouse through the use of waste heat energy. As equipment is added to the Data Centre, savings are expected to rise significantly. Greenhouse gas emissions will be reduced by an estimated 170 tonnes per year when the Data Centre is fully built out. Eliminating the need for boilers has also saved capital costs during design and construction of the building.

Additional heat recovery from the building is achieved through a heat wheel in the air handling unit serving supplementary spaces such as offices. Heat energy that would otherwise be rejected from the building is recovered by the heat wheel and used to preheat make up air for supplementary spaces.

Multipurpose & Record Storage Building – Inuvik



PWS is installing two interchangeable systems for heating in the new Multipurpose Building and Records Storage Building in Inuvik. The basic heating system will be fuelled by natural gas that is readily available in Inuvik. Natural gas fired boilers are more efficient than oil and produce fewer greenhouse gases. The second building heating system, which will act as the primary load system, will utilize excess heat from adjacent NTPC power plant generators. This heat will be purchased from NTPC at a rate significantly below the cost of heat provided by the gas fired system.

Generators located at the NTPC power plant produce waste heat as a by-product during electricity generation. Typically this excess heat is rejected in the exhaust and jacket water (cooling water). Through a heat recovery piping system, this waste heat energy will be used in both the Multipurpose Building and Records Storage Building as the primary heat source for the buildings.

In addition, a small Data Centre is being provided within the Records Storage Building. A heat recovery system is being installed to utilize this waste heat to partially satisfy the heating requirements of the Records Storage Building.

Miscellaneous Energy Conservation Projects

Various facilities such as the Central Warehouse (Yellowknife), North Slave Regional Office (Yellowknife) and the N'Dilo Gym were reviewed in Technical Status Evaluations to identify opportunities for energy conservation, which resulted in replacing the existing central control systems in each of the quoted buildings with direct digital controls. These controls provide far greater accuracy and flexibility of control, thus providing significant energy savings.

In the fiscal year of 2009-2010, the Central Warehouse energy retrofit project resulted in 9,502 litres of fuel oil savings, equivalent to approximately $7,602 in savings and a GHG reduction of 18 tonnes.

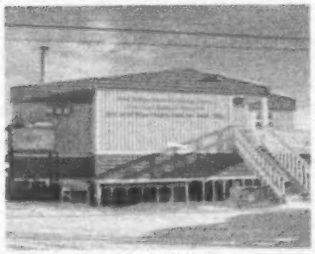
The North Slave Regional Office energy retrofit displaced 12,678 litres of fuel oil in the fiscal year of 2009-2010. This reduction in fuel oil is equivalent to approximately $10,148 in savings and a GHG reduction of 22 tonnes.

The N'Dilo Gym energy retrofit displaced 12,427 litres of fuel oil in the fiscal year of 2009-2010. This is equivalent to approximately $9,942 in operational savings and a GHG reduction of 21 tonnes.

Energy Upgrades - DDC Upgrade
N'Dilo Gymnasium,
N'Dilo (Yellowknife)

Energy Upgrades - Air Barriers
GNWT Warehouse,
Yellowknife

Energy Upgrades - Ventilation
North Slave Regional Office (PWS),
Yellowknife



Energy Upgrades - Lighting
Community Learning Centre,
Aklavik

Energy Upgrades - Lighting
Health Care Centre,
Ft. McPherson

Energy Upgrades - Envelope
Nurses Residence,
Inuvik

Capital Asset Retrofit Fund

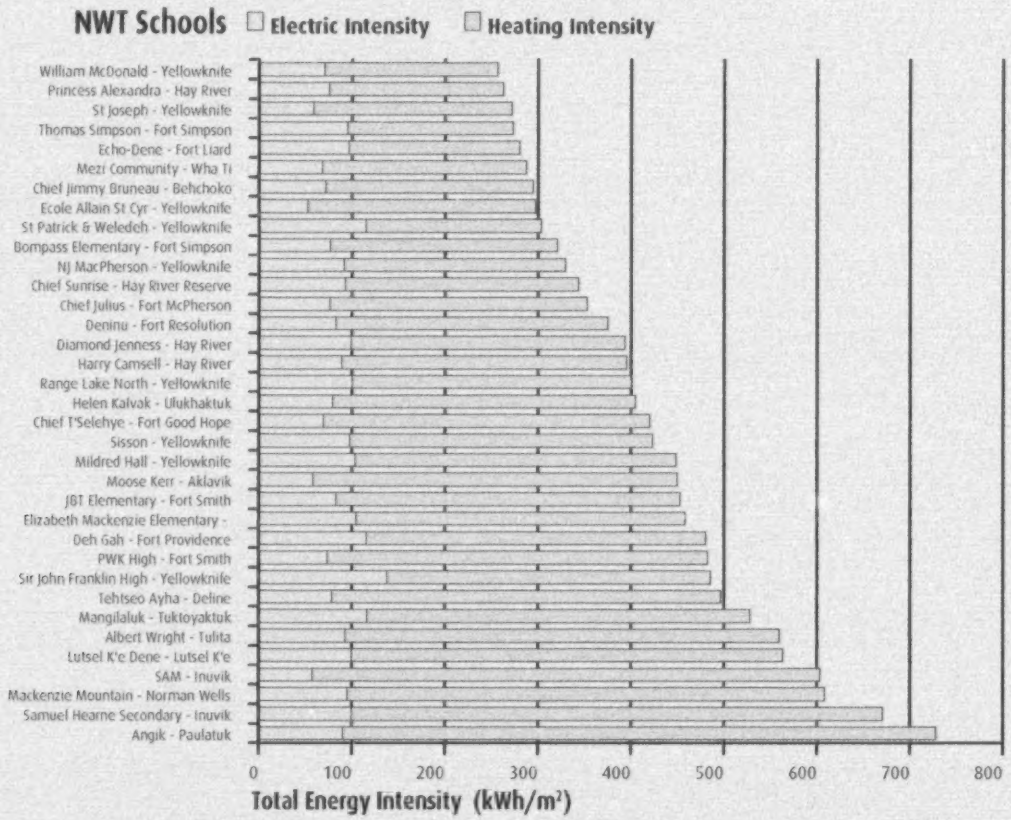
The Capital Asset Retrofit Fund (CARF) was established to upgrade existing GNWT buildings which are not energy efficient. The program will assist the government in reducing building operating costs and greenhouse gas emissions in the Northwest Territories. The GNWT owns more than 100 buildings built before 1980. Without retrofits, these assets will continue to deteriorate, causing operation and maintenance costs to rise.

Data collected through energy benchmarking, infrared thermal scanning, preliminary technical evaluations, energy consumption monitoring, mechanical and electrical system analyses, detailed energy audits, technical status evaluations, facility condition assessments and other on-site or background research is used to select optimum buildings for energy upgrades/retrofits. Upgrades/retrofits reduce energy consumption and greenhouse gas emissions as well as operational maintenance costs in GNWT assets.

Pre-Audit Study

PWS gathers utility information from numerous buildings to assess and compare building energy and cost intensities. This benchmarking allows PWS to compare like buildings such as schools, health facilities, commercial spaces etc., to determine which buildings have a larger than average energy intensity. Indices in units such as total energy intensity in kWh/m^2, as displayed in Figures 1 and 2, utility cost intensity in $/m^2, energy intensity by degree days (kWh/1000 HDD/m^2) and the total cost of utilities (fuel oil, propane, natural gas, electricity, etc.,) allow PWS to limit their selection of possible candidates for a full energy audit. Buildings with high energy intensity and utility costs are prime targets for energy retrofits as they yield the greatest opportunity for energy savings, cost savings and an overall greenhouse gas reduction. Buildings with large energy intensities yield lower payback periods making them financially more appealing.

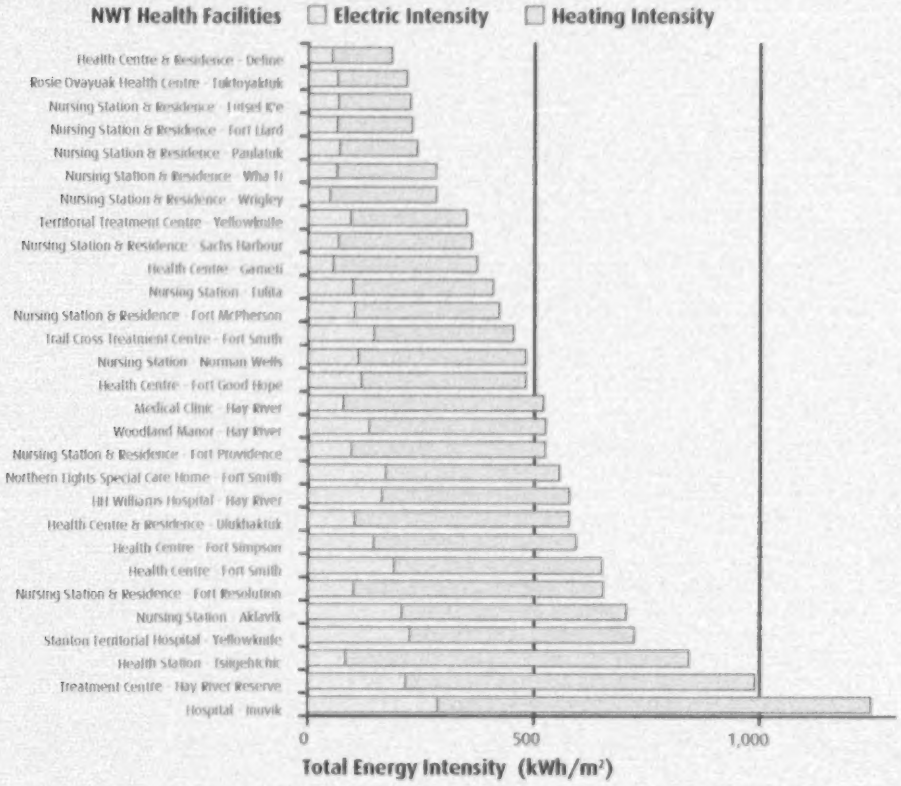
Figure 1: Example of Large NWT School Benchmarking of Total Energy Intensity



PWS has completed energy benchmarking studies on large schools and health facilities. The large schools benchmark was completed for the 2006-2007 fiscal year and included 35 schools in 20 communities. The health facilities benchmark was completed for 2007-2008 and included 29 buildings in 26 different communities.

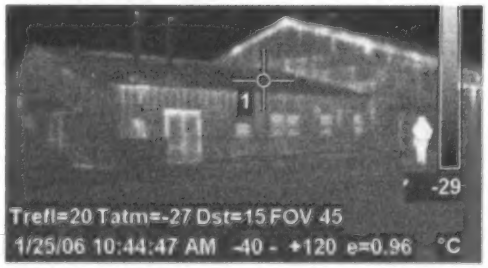
Office buildings greater than 250 m^2 in size are currently being benchmarked for the fiscal year of 2010–2011. All together, 17 GNWT buildings will be benchmarked in nine different NWT communities.

Figure 2: GNWT Health Centre Benchmarking of Heating Intensity with Respect to Heating Degree days


NWT Health Facilities
Electric Intensity
Heating Intensity
Health Centre & Residence - Deline
Rosie Owayuak Health Centre - Tuktoyaktuk
Nursing Station & Residence - Lutsel K'e
Nursing Station & Residence - Fort Liard
Nursing Station & Residence - Paulatuk
Nursing Station & Residence - Wha Ti
Nursing Station & Residence - Wrigley
Territorial Treatment Centre - Yellowknife
Nursing Station & Residence - Sachs Harbour
Health Centre - Gameti
Nursing Station - Tulita
Nursing Station & Residence - Fort McPherson
Trail Cross Treatment Centre - Fort Smith
Nursing Station - Norman Wells
Health Centre - Fort Good Hope
Medical Clinic - Hay River
Woodland Manor - Hay River
Nursing Station & Residence - Fort Providence
Northern Lights Special Care Home - Fort Smith
HH Williams Hospital - Hay River
Health Centre & Residence - Ulukhaktuk
Health Centre - Fort Simpson
Health Centre - Fort Smith
Nursing Station & Residence - Fort Resolution
Nursing Station - Aklavik
Stanton Territorial Hospital - Yellowknife
Health Station - Tsiigehtchic
Treatment Centre - Hay River Reserve
Hospital - Inuvik
0
500
1,000
Total Energy Intensity (kWh/m²)

Thermal Analysis

Public Works and Services conducted site visits to perform thermal imaging on buildings identified by a pre-assessment of their energy intensity. Thermal images help to assess the condition of a buildings envelope and can immediately identify energy saving measures. In addition, thermal scanning of a building can identify issues such as glycol leaks in radiant floor slabs, pinpoint poor electrical connections, and find leaks in roofs and condensation in building envelopes.



Since the implementation of thermal scanning in 2006, over 400 GNWT and municipal buildings have been scanned in the communities of Hay River Reserve, Buffalo River, Dory Point, Kakisa, Enterprise, Fort Providence, Fort McPherson, Tsiigehtchic, Tuktoyaktuk, Fort Resolution, Tulita, Deline, Fort Good Hope, N'Dilo, Behchoko, Norman Wells, Fort Smith, Inuvik, Aklavik, Paulatuk, Sachs Harbour, Fort Simpson and the Yellowknife regions.

In conjunction with thermal scanning, PWS also conducted 250 building mechanical and electrical system surveys. These surveys identified out of date mechanical and electrical systems based on PWS building guidelines, and recommended required retrofitting measures.

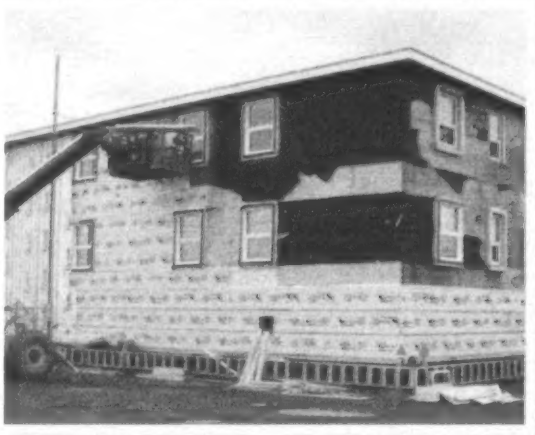
Detailed Energy Audits

Detailed energy audits are conducted on buildings that have been identified by PWS as high energy users (by comparison). Deliverables from an energy audit include a complete building and system description, a comparison of historical energy usage with weather data, an outline of energy usages by type (i.e., lighting, space heating, domestic hot water, etc.,) identification of potential energy saving measures and operating benefits, cost estimates and returns on investments, and forecast modelling of energy usage with implemented energy saving measures.

PWS has completed 43 energy audits of GNWT buildings. Audits have been completed in a number of communities such as: Aklavik, Buffalo River, Deline, Enterprise, Fort Good Hope, Fort McPherson, Fort Providence, Fort Simpson, Hay River, Hay River Reserve, Inuvik, Lutsel K'e, Nahanni Butte, Norman Wells, Paulatuk, Tsiigehtchic, and Tuktoyaktuk. In the past year PWS has completed 10 energy audits on the following buildings: Aklavik Nursing Station, Moose Kerr School (Aklavik), Health Centre (Fort Good Hope), Health Station (Tsiigehtchic), Hospital (Inuvik), Inualthuyak School (Sachs Harbour), Helen Kalvak School (Ulukhaktok), Health Centre & Residence (Ulukhaktok), Chief Julius School (Fort McPherson), and the Health Centre & Residence (Fort McPherson). PWS uses these energy audits to formulate work plans for energy efficiency upgrades in the coming years.

Energy Retrofit Projects

Following a preliminary and detailed energy audit, Public Works and Services develops a full scope of work for an energy retrofit project. Energy savings measures are appropriately selected for construction based on the recommendations from a detailed energy audit. Typically, energy retrofit projects are combined with operation and maintenance items. Consolidating these projects based on location and a common scope of work helps to reduce costs for project management and give economies of scale for a best price overall.



Typical energy saving measures that PWS would install in an energy retrofit include: the conversion of old magnetic ballast T12 fluorescent fixtures, to electronic ballast T8 lighting, exit light conversion from incandescent to LED, indoor incandescent lighting converted to CFL's, outdoor incandescent lighting converted to high pressure sodium, installation of occupancy sensors for lighting operation, VFD installations on air handling units and pumps, replacement of large electric water heaters with propane or oil instantaneous water heaters in diesel communities, refining of run schedules on domestic hot water pumps and AHUs, re-balancing of AHUs, installation of controllers on large boilers, addition of heat recovery on air handling units, installation of building wide DDC controls, efficient plumbing fixture installations, and building envelope upgrades such as the replacement of windows and doors, siding and roof repair, re-insulation in problem areas.

During the construction period PWS will frequently assess the quality and progress of the construction project. PWS is involved in the performance verification of a capital asset retrofit project to ensure that all the measures are installed as specified and are operating within design limits. The performance verification of an energy retrofit project is a key component to ensuring that the measures meet or exceed energy saving forecasts.

After the completion of a project, Public Works and Services will monitor the utility information to track real savings of the energy retrofit. Real savings can then be used to create a self-perpetuating retrofit plan used to increase energy savings in GNWT buildings.

The reduction of energy usage and greenhouse gas emissions through CARF, generates real dollar savings and enables the GNWT to follow its 2007 Energy Plan and Greenhouse emission reduction targets by reducing the need for large outlay of O&M funding to maintain the building. A capital asset retrofit project helps to increase the useful life of a building and its assets.

GNWT assets currently undergoing an energy efficiency retrofit include: Stuart Hodgson Building (Yellowknife), Air Terminal Building (Fort Simpson), 4-Bay Garage (Fort Simpson), Ferry Camp Building (Fort Simpson), Harry Camsell School (Hay River), PWK High School (Fort Smith), Nurses Residence (Inuvik), Grandfather Ayha School (Deline), Mangalaluk School (Tuktoyaktuk), Health Centre (Tuktoyaktuk), Air Terminal Building (Aklavik), Community Learning Centre (Aklavik), Mackenzie Mountain School (Norman Wells), Air Terminal Building (Norman Wells), Angik School (Paulatuk), Health Centre (Fort McPherson), Health Center (Tsiigehtchic), Health Centre (Sachs Harbour).

Public Works and Services is continually investigating the feasibility of energy retrofits in order to make use of the Capital Asset Retrofit Fund. Currently PWS is considering energy retrofits in numerous buildings throughout the NWT: the Nurses Residence (Inuvik), Inuvik Regional Hospital (Inuvik), Deh Gah School (Fort Providence), Moose Kerr School (Aklavik), Thomas Simpson School (Fort Simpson), Nurses Residence (Fort Good Hope), Helen Kalvak School (Ulukhaktok), Health Centre and Residence (Ulukhaktok), Chief Julius School (Fort McPherson), Health Centre and Residence (Fort McPherson), Inualthuyak School (Sachs Harbour), Stuart Hodgson Building (Yellowknife), Mackenzie Mountain School (Norman Wells), Elizabeth Mackenzie School (Behchoko), Chief Jimmy Bruneau School (Behchoko), and the Angik School (Paulatuk).

Design of Energy Efficient Buildings

PWS uses Natural Resource Canada's energy-efficiency standards (i.e., the Eco-Energy Validation Protocol) as a minimum standard during the design and construction of both new and renovated GNWT buildings. The main benefit to the GNWT is the immediate reduction of fuel and power consumption, resulting in long-term operating cost savings. Greenhouse gas emissions are also reduced. All PWS projects above a certain size and complexity are to be designed and built to the Eco-Energy Validation Program as a minimum requirement.

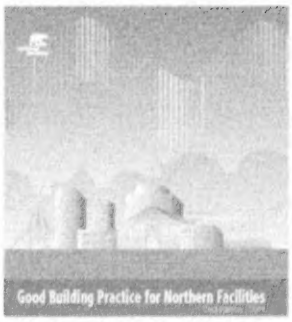
PWS has created and continues to update (the second edition was released in 2009) its own building specification guide referred to as the "***Good Building Practice for Northern Facilities***" (GBP). This guide takes into account many aspects of good building design from NRCan but also includes special requirements and guidelines for building design in the North. These guidelines have been developed through PWS's experiences with designing and constructing numerous buildings in the North.

PWS is also involved in the publication of the brochure "***Energy Conservation Design in GNWT Buildings***". These publications help designers, project managers and project officers decide how to design and construct a Northern building and select energy conservation features for a particular project.

Energy Modelling

PWS requires that the design for all large facilities follow a review process which in part requires an energy modelling workshop. This energy modelling workshop brings the energy modelers, designers, PWS technical staff and the end user together to discuss the intended use of the building and how it can be constructed to perform as energy efficiently as possible. Typical items that are modelled include various types of insulation, its thickness and application method, heating systems (high temperature, low temperature), boiler plant options (condensing boilers, biomass, geothermal), window glazings, control strategies and a number of other items that all have an affect on the performance of the building. Each individual measure is modelled to determine energy savings and the impact on up-front capital costs to implement. The outcome of the energy modelling workshop assists the designers, PWS technical staff and end users in selecting a design that optimizes both energy performance and capital costs. An example of the success of this energy modelling is the new Inuvik School currently being constructed; the energy modelling workshop assisted designers in making the building 56.1% better than the Model National Energy Code for Buildings (MNECB) reference building (Validated by EcoEnergy).

Good Building Practice for Northern Facilities (2009)



A building designed using the GBP guidelines meets the energy performance standards of the Eco-Energy Validation Program. In general, a building designed to GBP guidelines performs more than 25% better than a building designed to the 1997 Model National Energy Code for Buildings (MNECB). The Second Edition of ***"Good Building Practice for Northern Facilities"*** (GBP) was published in May 2009 and posted on the PWS website. It is a mandatory requirement that all GNWT buildings meet the requirements of ***"Good Building Practice for Northern Facilities 2009"*** (except some selected specialty buildings).

Since the publishing of the original GBP guideline, PWS has overseen the design and construction of a number of buildings that have been designed and constructed according to the ***"Good Building Practice for Northern Facilities"***.

All new and renovated GNWT buildings incorporate the GBP guidelines during their design and construction. PWS has an active role in ensuring that all designers and contractors follow these guidelines by reviewing drawing submissions at various levels of completion in design, conducting site walkthroughs and follow up visits during construction and commissioning of newly constructed facilities.

PWS is continually involved in the design review and construction of new GNWT buildings. Buildings currently in the design and construction phase include: Combined Schools Project (Inuvik), GNWT Multi-Use Facility and Records Centre (Inuvik), Health Centre (Fort Smith), Diamond Jenness Secondary School (Hay River), Community Learning Centres (Hay River Reserve, Lutsel K'e and Tsiigehtchic), Western Arctic Research Centre (Inuvik), New GNWT Office Building (Yellowknife), Regional Health Centre (Hay River), Health Centre and Long Term Care Facility (Norman Wells), Long Term Care Facility (Behchoko), and Health Centre (Fort Providence).

National Energy Code for Buildings Development

The current Model National Energy Code for Buildings (MNECB) has been in place since 1997, and is now being updated. It is used as a guideline for energy conservation practices. The 2010 edition of the NECB will raise the energy efficiency requirements from the current version. It will be simpler and more user-friendly than the current version. Energy use levels mandated by the 2010 edition will be reduced from those in the 1995 code. The new code, will reflect up-to-date equipment and system efficiencies and current building practices. Public review of the NECB occurred during October and November of 2010. Publication of the NECB is anticipated in late 2011.

PWS technical staff continues to participate in national energy-related code development committees. They have one representative on the Canadian Commission on Building and Fire Codes, one on the Building Energy Codes Collaborative, and one on the National Energy Code for Buildings (NECB) Committee. PWS is also involved in the Public Infrastructure Engineering Vulnerability Committee (PIEVC), which studies the impact of climate change on northern engineered infrastructure, and with the Building Technology Transfer Forum(BTTF), which meets to share new technology information across many jurisdictions.

Performance Verification – Commissioning

The performance verification process ensures that the GNWT is provided with a building that meets all the design requirements and operates as intended. This ensures a code-compliant, healthy, and comfortable environment for occupants and a building that operates at peak efficiency to reduce energy consumption, operating costs, and greenhouse gas emissions. Building systems should function as designed and O&M staff are better prepared to operate and maintain the buildings.

Commissioning GNWT Funded Buildings

What is Building Commissioning?

Projects where performance verification has been completed include: Chief Albert Wright School (Tulita), ENR Wildlife Lab (Yellowknife), Mildred Hall School Renovations (Yellowknife), Aurora College Student Housing (Inuvik), École Allain St. Cyr Addition (Yellowknife), Chief Jimmy Bruneau Boiler Replacement (Behchoko), GNWT Office Bldg (Fort Simpson), Adult Supported Living-Housing Phase (Hay River), Tapwe Building Air Conditioning Unit Replacement (Yellowknife), Corix Water Treatment Plants (Behchoko, Holman, Aklavik, Deline and Tuktoyaktuk), Central Heating Plant Renovations (Fort Simpson), Jean Wetrade School Addition (Gameti), K'alemi Dene School (N'Dilo), New Data Centre (Yellowknife), Diamond Jenness Trades Shop (Hay River), Northern Lights Senior Centre Addition (Fort Smith), Combined Services Building (Yellowknife Airport) and Chief T'Selehye School (Fort Good Hope).

Consolidation of Utilities

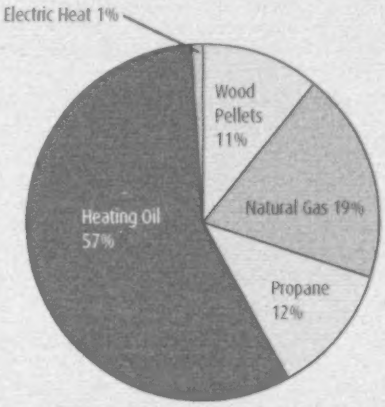
In 2010–2011, the responsibility for utility payments on all GNWT assets was transferred to PWS.
In 2010–2011, PWS commenced:

- Tracking utility budgets, expenditures and consumption data in the GNWT's SAM System
- Assessing utility savings achieved through energy management initiatives completed on GNWT building infrastructure
- Identifying realized utility savings created through its energy conservation initiatives to establish funding that will be used to offset the cost of delivering future energy conservation projects

In the fiscal year of 2010–2011, utility payments totalled approximately $24,000,000. The consolidation of utilities funding by PWS and tracking of utility budget through the SAM system allows PWS to see exactly how the utility budget is spent.

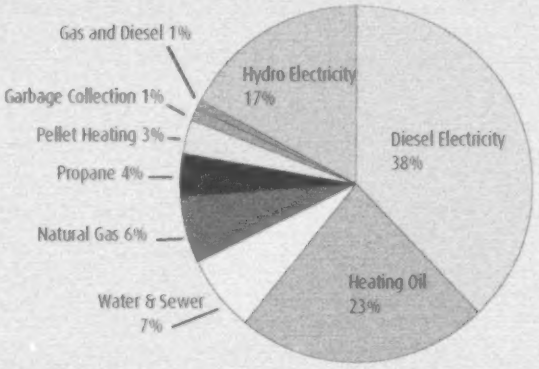
2010-2011 Space Heating Distribution by Energy Type (GNWT Maintained Assets)

Total Space Heating Energy Used in 2010-2011: 386,369 GJ



The GNWT SAM System allows PWS to track and break down utility consumption by source. The above graph indicates that PWS managed assets used approximately 12% renewable energy for space heating in the fiscal year of 2010/11.

Total 2010-2011 Utility Breakdown. Utilities totaled approximately $24 million



Asset electricity use accounts for 55.09% ($13,100,000) of the utility budget. Of the $13,100,000 electricity expenditure, 31% ($4,135,000) was spent in communities such as Yellowknife, Hay River and Fort Smith where renewable hydroelectricity is utilized.

Fossil fuel purchases (heating oil, propane and natural gas), account for the next largest portion of the total utility budget ($24,000,000), approximately 32.6% ($7,824,000) of the total. Space heating energy use is high in the North; however, PWS biomass initiatives are offsetting the use of fossil fuels. In 2010-2011, biomass heating systems accounted for 3% ($722,000) of PWS's annual budget, and as seen in the above chart, they provided 11% of the space heating requirements.

Report Summary

PWS continues to design and implement energy efficiency measures to produce significant operational savings for the GNWT. Since the beginning of the energy saving initiatives in 2007 until the end of 2010, PWS Energy Savings Projects have saved approximately $996,461 of operational costs. These savings will continue to grow as more and more energy projects are implemented. PWS is anticipating operational savings for 2010–2011 (end) and 2011–2012 (end) to reach $1,657,400 and $1,881,200 respectively.

All energy conservation projects are helping to reduce the GNWT's reliance on fossil fuels; in particular, heating oil. Since 2007, PWS energy conservation projects have displaced approximately 3,842,491 litres of fuel oil and reduced GHG emissions by 10,472 tonnes, as seen in charts 3 and 4. At this current rate of fuel oil displacement, PWS Energy Conservation Projects will save approximately 70 million litres of fuel oil and 190,000 tonnes of greenhouse gas emissions over the next 25 years.

Chart 3: Reduction in Greenhouse Gas Emissions – Cumulative Total (Litres)
Biomass Heating, Electric Heat Conversion, Energy Retrofits and Miscellaneous Waste Heat Recovery Projects

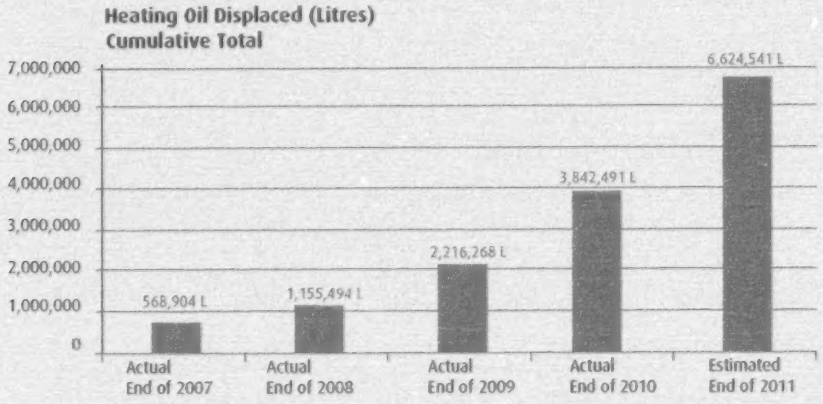


Chart 4: Heating Oil Displaced – Cumulative Total (Tonnes)
Biomass Heating, Electric Heat Conversion, Energy Retrofits and Miscellaneous Waste Heat Recovery Projects

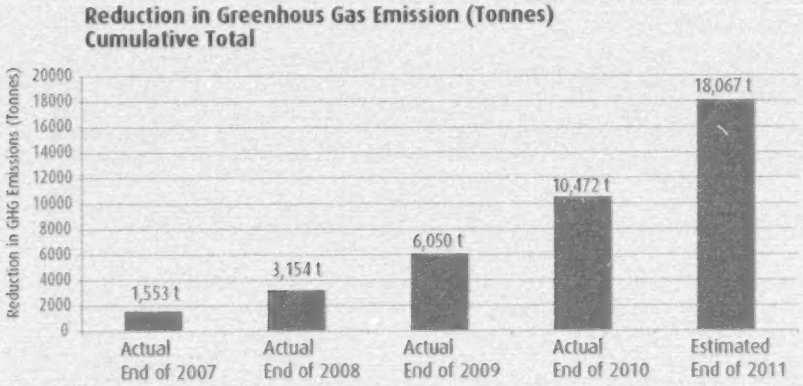
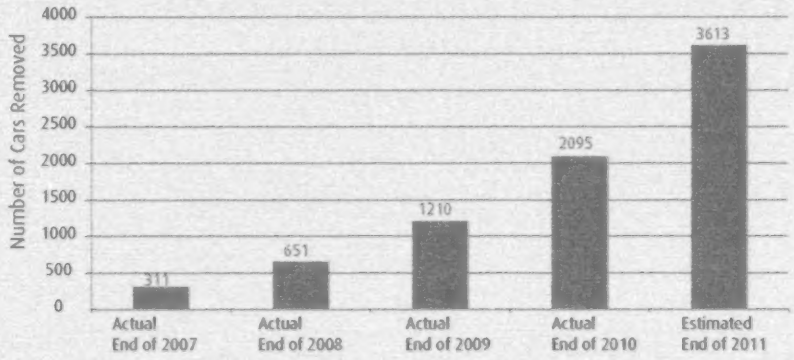
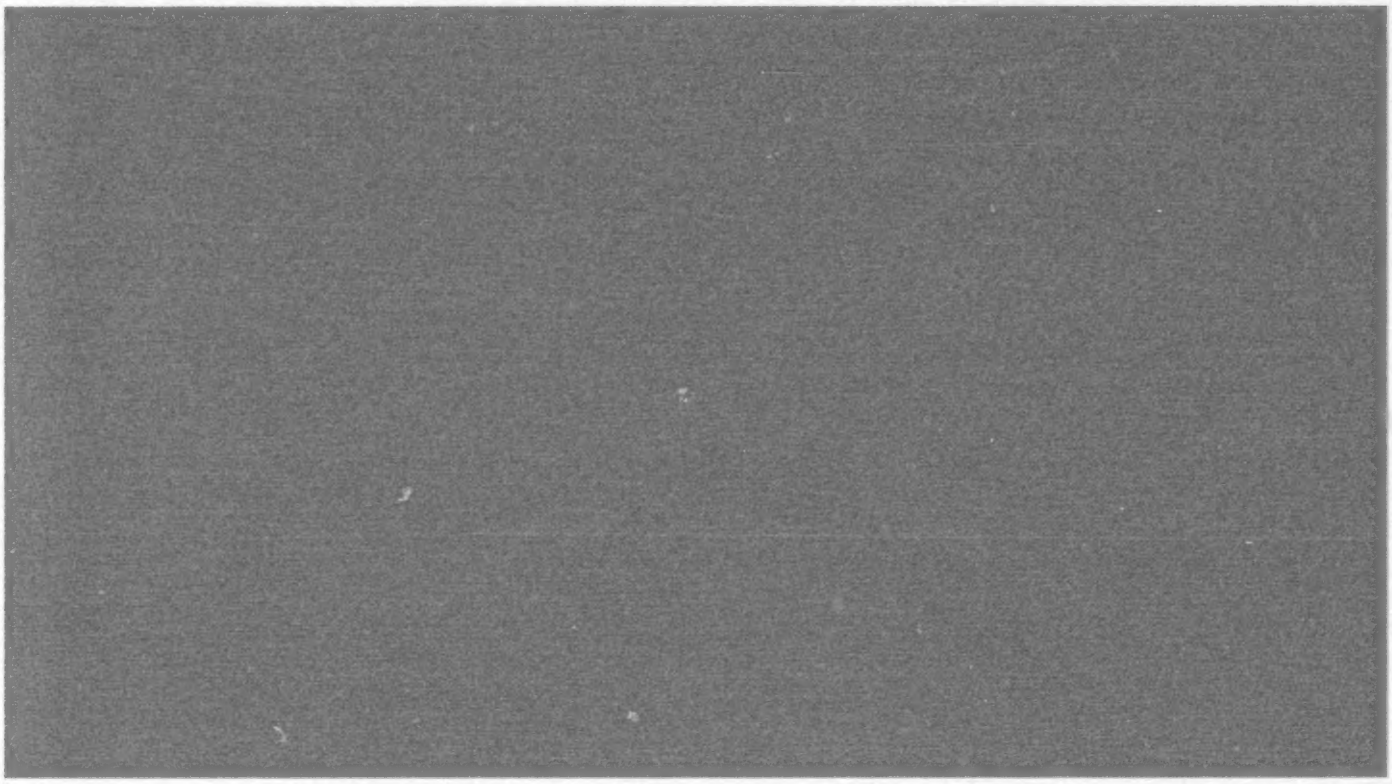


Chart 5 shows that with the implementation of the energy conservation projects and initiatives to December 31, 2010, greenhouse gas reductions equivalent to that of over 2100 vehicles were eliminated. It is estimated that at the end of 2011, that number will increase to 3613 vehicles.

Chart 5: Equivalent Number of Cars Removed Off Road: Cumulative Total – Biomass Heating, Electric Heat Conversion, Energy Retrofits and Miscellaneous Waste Heat Recovery Projects



End



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